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in Inner Southern Africa. The accounts of several Portuguese travellers were passed in review; and the author contended that their itineraries were so full and their various accounts so accordant, that, notwithstanding the paucity of their astronomical observations, the geographical information they imparted was quite reliable, and ought not to be set aside, as had been done in the construction of modern maps. The subject was argued with much learning, and a large map was exhibited to illustrate the views of the author. Some of the more striking points of difference between this map and the recent ones of Livingstone were the total separation of the rivers Liambeji and Zambesi (the upper and lower courses of the Zambesi) and the release of their affluents from the system of inosculation which, in recent maps, bind all those rivers together; and the north-west direction of Lake Nyassa, which was made continuous with Tanganyika, forming an elongated lake, called *Ñanja mucúro*.

The PRESIDENT said, Mr. Cooley was a distinguished critical geographer, who had spent his life in elaborating from many sources, particularly from those Portuguese travellers who have preceded our own, a vast variety of information. The present paper had been so recently communicated that he had not had time to read it through; but, finding that the observations were of a critical nature, and that they bore to a great extent upon the accuracy of Dr. Livingstone's observations, he thought it right that the criticisms should be read first, and that Dr. Livingstone's simple account of his last exploration along Lake Nyassa, which he had undertaken of his own accord, should come afterwards; and then, that gentlemen who were more or less acquainted with the country should discuss the papers afterwards. He wished the subject to be fairly discussed, and that all deference should be shown to Mr. Cooley's powers as a critical geographer, for he was sure the Society desired to do justice to every man, whatever his labours might be, whether in critical geography or in actual observation.

Mr. MARKHAM then read the following :—

2. *Letters from the Zambesi to Sir R. I. Murchison, and (the late) Admiral Washington.* By DAVID LIVINGSTONE, M.D., LL.D.

THESE letters comprised a narrative of Dr. Livingstone's last journey into the interior. The despatch containing instructions for the withdrawal of his expedition did not reach him until the 2nd of July, 1863, when the waters of the Zambesi had fallen too low for the *Pioneer* to be taken down to the sea. To improve the time, therefore, until the flood of December, Dr. Livingstone set forth, accompanied by the steward of the vessel, to finish the exploration of Lake Nyassa, and more particularly to decide whether a large river entered its northern extremity. The wreck of his boat in the rapids of the Shiré forced him to abandon the attempt to sail round

the lake; he therefore started to go to the northern end by land, pursuing for many days a north-westerly course so as to avoid a colony of Zulus, who were at war with the negroes on the western shores of Nyassa. In this direction he came upon a range of mountains, 6000 feet high, running north and south, and forming the edge of the table-land on which the Maravi dwell. Beyond this he turned to the north-east, and struck the shores of the lake at Kota-kota Bay in lat. $12^{\circ} 55'$ s. He here found two Arab traders engaged in building a dhow, to replace one which had been wrecked in crossing the lake. This is the point at which nearly all the traders in slaves and ivory cross on the highway between the eastern seaports and the Cazembe country of the interior. The Arabs had 1500 persons in the village, and were busily employed transporting slaves to the coast. One fathom of calico (value 1s.) is the price paid for a boy, and two for a good-looking girl. But, nevertheless, it is the joint ivory and slave trade that alone makes slave-trading a paying business; for the cost of feeding the negroes would be too great an expense were it not for the value of their services in carrying the ivory; a trader with twenty slaves must daily pay the price of one slave for their sustenance. All the difficulties which Dr. Livingstone had experienced in travelling in the interior were due to the obstacles thrown in his way by the Portuguese, who judged truly that in buying up the ivory he was undermining the slave-trade. He only hoped that this same course would be pursued by other travellers who might succeed him, as this did more to destroy the slave-trade than the English cruisers on the coast. Leaving Kota-kota Bay, Dr. Livingstone again turned due west, and in three days reached the ascent of the plateau. The long slope, adorned with hill and dale and running streams, fringed with evergreen trees, was most beautiful. The heights had a delicious, but peculiarly piercing air, which was very exhilarating. At this point, distant 80 or 90 miles from Nyassa, the watershed was crossed, and two rivers met with, both named Loangwa: one was found flowing eastward, into the lake; the other westward, towards the Zambesi. Another river was here seen, called the Moitawa, which flows into a small lake, called Bemba; from this river issues, according to native and Arab report, the River Luapula, which, flowing west, forms the Lake Mofue, and then, passing the town of Cazembe, turns to the north, and is lost in Tanganyika. Dr. Livingstone had a strong desire to follow the stream, but the time for the rising of the Zambesi and for floating the *Pioneer* out to sea having arrived, he was obliged to return. With regard to the existence of a large river flowing into the northern end of Nyassa from Tanganyika, Dr.

Livingstone was assured by all the natives of whom he inquired that there was no such stream, but that two small rivers alone enter the lake from the north. The numerous streams met with on this journey flowing from the west into Nyassa seemed to warrant the conclusion that no flow of water from Tanganyika was necessary to account for the great depth of the lake and the perennial flow of the Shiré. In this journey Dr. Livingstone and his companion walked 660 miles in 55 travelling days. On arriving at the Zambesi he found the river had not yet risen, the rains being much later than usual, and was mortified in the reflection that had he dared to speculate on a late rise he would have had ample time to examine the water-system of Lake Bamba.

The PRESIDENT was sure they would all agree with him that Dr. Livingstone had made the best possible use of his time as a geographer in this exploration to the north-west of Lake Nyassa, of which he had previously explored the western banks in company with Dr. Kirk. The observations of Mr. Cooley seemed to have no special reference to this communication respecting the outlines of Lake Nyassa and the mountains to the west and north-west of it. The map constructed by Dr. Kirk shows Lake Nyassa stretching directly north and south, a distance computed at 200 miles; but on Mr. Cooley's map the lake is made to trend to the north-west. There was, therefore, this great discrepancy between the observations of the Portuguese who visited that country many years ago, and the *de facto* recent observations of Dr. Livingstone and Dr. Kirk.

Captain SPEKE said he had a few remarks to make upon both papers. In the first place, Mr. Cooley, taking the Portuguese accounts, made a continuous lake of the Nyassa and Tanganyika. He himself was inclined to believe that at one period there really was such a union; and he thought there was still a connection between them, though not as a broad lake. When he was at Kazé he heard from the Arabs, and also from many of the natives, that the Babiza tribe, which inhabit the western shore of the Nyassa lake, cross a deep river by canoes, and find their ivory mart at a place called Luwemba, not far distant from the south-east corner of the Tanganyika. To this place the Arabs from Kazé, and their slaves, go for ivory. Thus whilst the Arabs draw their ivory up to Kazé, the Babiza take theirs down the western coast of Nyassa to Kotakota, where they sell it to Arabs, and from that point it is transported to Zanzibar by Kilua. All these trading people at Kazé told him that there is no mountain-range dividing the Nyassa lake from the Tanganyika lake; but they all talked of a river running as it were from one lake into the other, from which he inferred that the Tanganyika was drained by a river into the Nyassa. Dr. Kirk had assured him that no large river entered the Nyassa at its northern end. He should like to know from Dr. Kirk whether he derived his information from Arabs or from his own personal inspection. The river system of Africa is chiefly determined by the rainy system of that continent. Within the Tropics everything goes on in an exact ratio throughout the year, the rains following the path of the sun. The greatest rains are confined to the Equatorial line—the part to which the sun is nearest, on an average, the whole year round. Were it not for that rainy zone, the sources of the Nile would certainly not be on the Equator. The Tanganyika would not be in existence; nor, as he believed, the Nyassa either. Whilst the sun is in the north, the Nyassa lake, were it not supplied by the rains which are constantly falling on the Equator, would dry up, in the same manner that Lake Tchad dries up; that is to say, to a certain extent.

Again, with regard to Lake Dembea, in Abyssinia, we know what an enormous river this lake pours out when the sun is to the northward, and how it shrinks when the sun is to the southward. The size of that river is so prodigious in the rainy season that it overcomes the White Nile. But in the dry season, if it were not for the White Nile, the waters of that river would never reach Egypt, and there would be no Nile at all. The greatest possible importance must, therefore, be given to this system of rains, and he firmly believed that the existence of the Nyassa lake is due to the rains of the Equatorial regions. Upon reference to the map, they would see that the majority of the streams which flow from the mountain-range overhanging the west of Nyassa, turn off to the westward, and, as Dr. Livingstone imagines, drain into the upper course of the Zambesi river. So that but little water could possibly find its way into Lake Nyassa in that direction. On the eastern side of Nyassa we have the Ruvuma river draining all the countries to the east of it, in that latitude; and to the northward of that we have the Urunga branch of the Lufiji river. Then, there is that great chain of mountains which extends right down the coast of Africa from Abyssinia to the Cape of Good Hope, hemming the lake in on its eastern side. So that really the rains that can fall within the basin of the Nyassa are so confined that there would never be a lake of such enormous depth as that of which we have just heard, were it not supplied from much greater sources than these puny streams of which Dr. Livingstone tells us; for such they must really be, having their sources at so short a distance from the shores of the lake. Notwithstanding all that had just been said, he thought Mr. Cooley to a certain extent right in the view he had taken, that there is a long channel extending from the Tanganyika to the Nyassa, though instead of its being a continuous lake as of old the waters have dried up to midway, leaving the two lakes simply connected by a river. There was another thing which may appear extraordinary. They had heard from Dr. Livingstone that there were Zulu Caffres on the western shore of the Nyassa. Dr. Kirk also saw these men and spoke with them, and recognised them. From their dress and other circumstances he was certain that these very men, who have absconded from that region, have now gone up the eastern side of the Tanganyika, and have arrived at the southern border of the Usui, where they are known by the name of Watuta; for he heard of them on both journeys, when on the grand trading-line from Zanzibar to Tanganyika, and also when going from Kazé to Karagué. On this latter journey they were fighting on his line of march, had struck terror into the hearts of his followers, and had thereby delayed his progress a considerable time. He believed the Caffres generally migrated in the first instance from Abyssinia; that they gradually found their way down to the Cape, and there remained for a certain time until they were driven away; that then, this Zulu branch of the Caffres made their way to the western shore of Nyassa. They are a pastoral and predatory race, and live by seizing their neighbours' cattle, and harassing their country. They have harassed the whole of this country to the north-west of Nyassa; they have harassed the country half way up the Tanganyika; and they have gone up to Utambara. They are now the terror of the Usui; and before long they will probably arrive at the southern shores of the Victoria Nyanza. There was another point he should like to mention. On his former journey, when he was at Zanzibar, he met a very intelligent and energetic young German, Dr. Rosher, who had been very little heard of in this country. He believed Dr. Rosher was the first European who arrived upon the eastern shores of the Nyassa. After arriving at the lake he was, unfortunately for himself, induced, accompanied by two or three natives, to visit the northern branch of the Ruvuma river. One night, having put up at a village, he was suddenly surprised and deliberately shot with bows and arrows. The King of the country sent the murderers to Zanzibar, where, at the solicitation of our consul, Colonel Rigby,

they were beheaded by the orders of the Sultan of Zanzibar, in the presence of Captain Grant. Dr. Roshier sent home no observations of what he had done; but nevertheless, like Sir John Franklin in another direction, he had done a good work, and must not be forgotten. But further inquiry, and even Dr. Livingstone's own accounts, showed that the first promoters of the explorations into that region of Africa were right; he meant the missionaries, Mr. Rebmann and Mr. Erhardt. They gave the spring to the whole opening of this question; and the map which they made, which was certainly an extraordinary one, and which probably excited laughter at the time, had such an effect upon the Geographical Society that they determined to open up this region; and bit by bit they had done so. We have found out that the missionaries, generally speaking, were most accurate in all their accounts, so far, at least, as they understood their informants. Their distance from Kilua to the Nyassa is perfectly accurate, and their route from Zanzibar direct to Ujiji was almost the same that he himself made with astronomical observations. Therefore he thought geographers were greatly indebted to these two worthy missionaries.

Mr. GALTON did not agree with Captain Speke as to the equatorial regions of Africa alone having a sufficient rainfall to enable them to maintain rivers of first-class size. The Senegal, which rises on the verge of the Sahara, is a first-class river, as constant in volume throughout the year as the White Nile. The Gambia is no insignificant stream; and, further south, there is the mighty Niger. None of these is supplied from the equatorial zone. Independently of its Tchadda affluent, the Niger, which may be said to flow in part through the Sahara, is a stream superior, in the volume of water it carries, to the Upper White Nile, which comes from equatorial regions. South of the equatorial zone there is the great Zambesi. With respect to lakes, the Lake Tchad never dries up. It occupies an exceedingly shallow basin; and by losing a few feet of water in height its area materially diminishes; still at the driest time of the year there is an immense deal of water in Lake Tchad. Therefore he saw no difficulty for the maintenance of Lake Tanganyika and Lake Nyassa by tropical, and not equatorial rains. The outflow of Lake Nyassa through the river Shiré was, however, remarkably constant, and that constancy created a hygrometrical difficulty, which requires further explanation.

The PRESIDENT said he would now call upon the only person in the room who had sailed upon Lake Nyassa, and had been near its northernmost extremity, about which there had been so much discussion as to whether or no rivers flowed into it from the north. As that was the great point in dispute, and as Dr. Kirk had constructed the map of the lake now exhibited, the meeting would doubtless be pleased to hear any observations he might offer.

Dr. KIRK said he should limit his remarks to the hydrographic basin of the Nyassa, and afterwards say a few words about the Zambesi. Tracing Lake Nyassa from its southern end, in latitude $14^{\circ} 25'$, where they entered it by taking the boat up the Shiré, in 1861, they passed along its western shore for 200 miles, nearly south and north. The water was as blue as the tropical ocean, and in some places 115 fathoms deep. In sailing along its western coast they found seven rivers entering, seen from the boat. But in recent letters from Dr. Livingstone many other rivers were mentioned as coming in, and he expressly said that the amount of water thus brought in would be quite enough to account for the perennial flow of the Shiré. During the rains there must be a great excess in the water flowing into the lake over what flowed out of it. When they considered the extent of the lake, 200 miles in length, and its breadth from 15 to 60 miles, and knew that there was a rise of three feet during the rains, this would amply account for the surplus water then poured in. Considerable importance appeared to be attached to the north end. That part of the lake had not been seen by any of their party. The furthest point north

reached by the boat in 1861 was latitude $11^{\circ} 20''$. They could then see mountains ranging along on the western side as far as latitude $10^{\circ} 55'$; they could also see the bearings of a mountain on the eastern side, named Kumara, a name which, in the native language, means "the ending." He did not, however, attach much importance to native names; they are established often on very frivolous bases. However, it was clear that the lake was narrowing, from 60 miles, which was its breadth a little way south, to 15 miles. The natives told them that in five days' sail (and they named the stations and the intermediate places on the north end of the lake) they would double it, and would reach a point on the eastern shore opposite to where they then were. This information seemed very definite, and all the party placed reliance upon it. As to a river coming in from the north, the only ones they heard of were two small ones, one named in a generic way the Rovu, which means simply "river," and the other which they described as a small river coming in from a marsh. Whether this has any connection with the Tanganyika, he was not prepared to say; but it would seem to have very little to do with the supply for the Nyassa. It cannot be of any great size, for the Zulus, passing up the east side of the Shiré, and taking off the cattle from the east side of the lake, doubled its north end; and the Livingstone party saw them, still with their cattle, on the north-west side. Now, the Zulus are a race who never cross water if they can possibly avoid it; and he did not see how they could have crossed a lake with the considerable quantity of cattle which they took with them. The amount of rain which falls in the region of the Nyassa is very much larger than is generally supposed. Even on the Zambesi, as far south as Tete, the rainfall varies from thirty to forty inches in the year. Along the coast-range of hills the precipitation is very much greater. There is a narrow and lofty band of mountains which separates the Nyassa from the sea; and the inland side of that range is the one on which the greatest precipitation takes place. In the diagram prepared by Mr. Cooley they would observe that the course given to the lake is very different from that which he and Dr. Livingstone found, and that no river was marked as issuing from its southern end. Now, they found the Shiré coming out there. They took the boat up first through the Zambesi; branching off from that at the junction with the Shiré, they passed 100 miles up that tributary. Then, taking advantage of the smooth reaches, they travelled 40 miles by land, taking the boat along with them, but never for a moment losing sight of the Shiré; launching the boat again, they sailed 60 miles into the lake which the Shiré enters without obstruction. They found the lake lying due north and south, both by compass bearings and by absolute observations of longitude.

There was a discrepancy in another part of Mr. Cooley's map, at a point where he had the opportunity of making personal observations, namely, the portion between the upper and lower course of the Zambesi, which is marked unknown in the map, and the lower course is treated as a quite distinct river. Now, he had, by his own observations, almost connected the lower with the upper Zambesi. In marching from Tete their party followed the river on foot as far as a village called Mpanda. From that point they struck up into the mountains, and crossed to Sesheke. But in coming back from where the Makololo chief was then living, they descended from the Victoria Falls eight miles down the Zambesi by land; then, to avoid rough mountains, and save themselves a great deal of climbing, they determined to keep out about 10 miles from the river, thus leaving in all only about 30 miles of the Zambesi unexplored. At Sinamane, which is 40 miles from the Victoria Falls, taking a canoe, they navigated the whole course of the Zambesi, passing its affluents, the Kafue and the Loangwa, at Zumbo; but finding the rapids of Kebrabassa insuperable, they again went on land, and followed the Zambesi down to Tete. He therefore thought that, so far, the continuity of the Zambesi was pretty well

determined. Again, on the south bank the course of the river appears equally well traced. In a letter to Sir William Hooker, Mr. Thomas Baines mentions having started from Victoria Falls, and passing a little out from the river, in order to avoid rough country, again having struck the river about 10 miles further down. So that the unknown part of the river and country is limited to a radius of 20 miles at the utmost.

In conclusion, with regard to Lake Nyassa, he would state that the native information was tolerably definite concerning rivers entering the lake on the north-west. Their party met Arabs, the same as those mentioned in Dr. Livingstone's letter as building the dhow. They had travelled along that country from Katanga and Cazembe, the two great marts of the interior. They spoke of the Loapula, running to the northward into a small lake; but on being examined, it appeared to have no connection with the Tanganyika; and when asked about the small rivers coming in at the north end, they assured Dr. Livingstone that they were of no great size. The more recent information which Dr. Livingstone had gathered seemed entirely to confirm what was obtained in 1861.

Dr. BEKE wished to say a few words with reference to the supposed connexion between the two lakes, which he had questioned since 1849, though he had not cared to argue the point with Mr. Cooley.* According to Captains Burton and Speke, Lake Tanganyika lies 1844 feet above the ocean. Dr. Livingstone estimated Lake Shirwa at 2000 feet. He has not yet given the altitude of the Nyassa; but several years ago he reported that its waters had been described as being separated from those of the Shirwa by a mere spit of land: whence it was concluded that a communication of some sort must exist between these two lakes.† Assuming this to be the case, and the fact being also that, between Nyassa and Tanganyika, Dr. Livingstone has recently come upon a range of mountains, 6000 feet high, running north and south, and forming the edge of the tableland—being, apparently, a continuation of the Mountains of the Moon—it follows that a connexion between Nyassa and Tanganyika is physically impossible. Captain Speke had described the flow of water from the Lake of Dembea (Tsana) as being so immense that it exceeded that of the White River. But this lake could not furnish to the Nile more water than falls within the area of its basin, which forms but a small portion of that of the Blue River. All the water which issues from Lake Tsana passes under a single-arch bridge built by the Portuguese; and, as is stated in the Society's 'Journal' (vol. xiv. p. 48), when describing Dr. Beke's visit to the spot, on March 4th, 1843, "the river runs here with great violence through a deep fissure in the rock, so narrow that just above the bridge it may be leaped over. I should say it cannot be more than 2 yards in width." Father Jerome Lobo relates that in his time, before the bridge was erected, the whole army of the Emperor of Abyssinia passed over the chasm containing the river by means of beams of wood laid across it.

Mr. MACQUEEN said that on Mr. Cooley's map the places, according to Portuguese observations, especially the capital of Cazembe, were placed wrong. As for the lake which Dr. Kirk has laid down, it is quite correct; it has been known for more than two hundred years to lie in the very direction in which he has put it. There can be no connexion between the Nyassa and the Tanganyika—it is impossible; the country between Tete and Cazembe has been

[* See the 'Athenæum' of May 19th, 1849, p. 516, and July 12th, 1856, p. 867.—Dr. B.]

[† See Earl De Grey's Anniversary Address, 1860, in the Society's 'Journal,' vol. xxx. p. clxi. I have since been informed by Dr. Kirk that he makes the elevation of Lake Nyassa to be only 1520 feet above the sea; but this does not affect my conclusion.—July 5th, 1864.—Dr. B.]

traversed many times of late years, and nobody ever heard of a connexion between them. In the old Portuguese maps (see 'Annaes Maritimas,' No. 7, of 1844) the Lake Nyassa is laid down very nearly correct, both in latitude and longitude. He had worked at African subjects for sixty years, and he had been in possession of the Portuguese documents for nearly twenty years. There was a very valuable Arabic map that Admiral Washington showed to him twenty-five years ago, which he would ask the Society to make some inquiry about. It was one of the best maps he ever met with, well executed by a man who perfectly well knew what he was about, giving an account of the sources of the Congo, and all those rivers which run westward from Darfur. It was a very valuable map, and he had never seen it since.

The PRESIDENT said Mr. Macqueen's observations were very important. For sixty years he had laboured upon this subject. He has been a great collector of Portuguese authorities, and he must say that he had great confidence in Mr. Macqueen as a critical geographer. Now, Mr. Macqueen stated that the Portuguese had laid down their map of Lake Nyassa just as Dr. Livingstone and Dr. Kirk have laid it down.

Mr. MACQUEEN: Exactly so. In 1623 you find the southern or small lake laid down in the very latitude and longitude where Dr. Livingstone has laid it down. Thus, Father Godinho, in 1823, obtained from a countryman of his clear accounts of this part of Africa. The small lake he called Zachaf extended from 15° south latitude to 15° 50' south latitude. Again Monteiro and Gamitto (see their Journal, 1832, Muata and Cazembe, p. 48), say the south end of the great lake was 6 days' journey north from the small one, and was of "extraordinary breadth," 45 geographical miles, and very deep. Dr. Livingstone says it is about 50 miles broad at its south end. Monteiro calls it Nhianja or Nhianza (so does Lacerda in 1798), and that it runs a great distance due north. And so we find it.

The PRESIDENT was afraid this knotty question would never be completely decided until they had induced Captain Speke or some other traveller to go and do as Dr. Livingstone and Dr. Kirk had done with Lake Nyassa. When gentlemen go into such countries, risking their lives to search out the truth and making astronomical observations which fix latitudes and longitudes, it is obvious that all preceding accounts, derived from Portuguese and Arab travellers who did not make such observations, must give way to facts. Therefore, let us return our thanks to Dr. Livingstone and Dr. Kirk for their practical observations, and also to Mr. Cooley for his paper, which has given rise to so animated a discussion.

Portions of letters were then read from Dr. Baikie, Baron Theodor von Heuglin, and M. du Chaillu.

3. *Letter from Dr. Baikie.* Dated Lukoja, on the Niger, October, 1863.

EXTRACTS read from this letter showed how successful Dr. Baikie has been in establishing satisfactory intercourse with all the native chiefs around the settlement which he has formed on the Niger. He expresses feelingly his desire to return home, to see his aged father, from whom he has been absent seven years; but nevertheless remains at his post.

The PRESIDENT eulogised the conduct of Dr. Baikie, and expressed a hope that, as the officer serving under him had proved himself competent to